Seasonal Trend in the Development of the Sex Forms of the Fire Ant, Solenopsis Geminata (Fabr.) var. Rufa (Jerdon), in the Pineapple Fields of Oahu[1]

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Although the distribution of the fire ant is not limited to pineapple fields but extends into sugar cane fields as well along the dry coastal regions of Oahu, the data herein reported have been collected solely from the first-mentioned area. They are the result of systematic surveys conducted over a period of two years to establish the time and duration in the occurrence of sex forms of the fire ant in pineapple fields.

The fields in which the surveys were made were distributed from Sanitarium Flats on the one end to Waialua on the other. Fields in the Kunia, Kipapa, Kemoo, Brodie and Helemano sections were also checked. Most of these fields were in ratoon although a few were examined during plant crop. Moreover, in some cases, the surveys were continued even after the pineapple plants had been knocked down for fallowing. Wherever possible, contiguous new fields were substituted for those disced down during the survey period. Throughout the 2-year period, from 11 to 15 representative fields were examined during each survey.

The surveys were made at 2-month intervals. At the end of the first year the periodicity of the surveys was slightly altered so that the surveys would fall on those months in which none had been previously made.

SURVEY METHOD

The nests along the field roads were examined for the presence of sex forms, either in the immature stages as larvae and pupae or in the adult stage as alate males and females. Precautions were taken to avoid undue disturbance of the nests resulting from too frequent disruptions, by alternately examining the roads, so that nests along any one road would be surveyed only once in six months, but due to the encroachment of *Pheidole* ants which gradually decreased the number of fire ant nests and the fact that some of the fields were too small to have enough roads to practice alternate examinations, the scheme was not strictly adhered to.

The presence or absence of the sex forms in a nest was determined by digging up the nest and examining its contents. The pro-

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cedure was simple during the wet fall to spring months when the immature stages were mostly confined to the surface and could be easily exposed with a scrape or a few thrusts of a shovel, but during the dry summer months, when they were being brooded at a depth of a foot or more beneath the surface, which had become compacted by the traversing of the heavy harvest trucks, real pick and shovel work was necessary to make the required examinations.

POPULATION TRENDS AND COLONY LIFE HISTORY

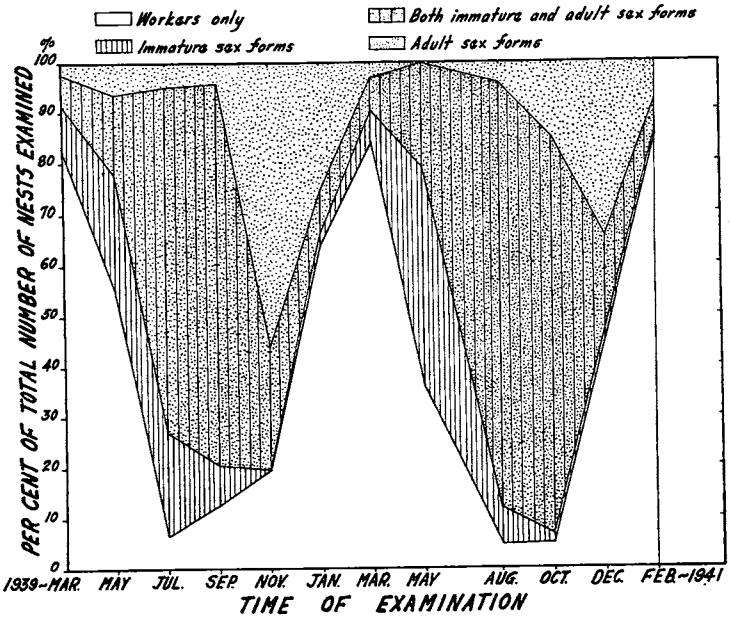
Since, with few exceptions, the general trends of population development in the fields in the different localities for any particular survey were found to be about the same, all the data have been analyzed collectively and set forth in Table 1 and graphically depicted in Fig. 1. The data obtained from the plant crop fields presented some slight exceptions to the general trend. Here, the majority of the nests found prior to harvest were small, many of them appeared to be incipient; but after the fruits had been picked and the field cleared for ratooning, the number and size of the nests along the roads not only increased but most of them contained mature as well as immature sex forms. This reaction would indicate that many of the colonies had been developing within the field blocks and had subsequently moved out into the roads only after the plant crop had been harvested. Due to this erratic behavior, all the records of examination made in plant crop fields were excluded from the analysis of Table 1.

TABLE 1.

A summary of survey data to determine the status of fire ant nests in regard to the presence of sex forms throughout the infested pineapple areas of Oahu from March 1939 to February 1941

Time of Survey	Total No. of Fields Surveyed	Total No. of Nests Examined	Nests with Immature Forms of Wkrs. Only		Nests with Immature Forms of Wkr. & Sex		Nests with Sex Forms in Addition to Worker Forms Imm. & Adult		Nests with Sex Forms in Addition to Worker Forms Adult Only	
			No.	%	No.	%	No.	%	No.	%
1939										
Mar.	12	409	337	82.40	38	9.29	25	6.11	9	2.20
May	12	494	272	55.06	113	22.87	79	15.99	30	6.07
July	11	354	24	6.78	72	20.34	241	68.08	17	4.80
Sept.	14	686	88	12.83	53	7.73	515	75.07	30	4.37
Nov.	10	439	86	19.59	0	0	106	24.15	247	56.26
1940										
Jan.	11	482	308	63.90	11	2.28	40	8.30	123	25.52
Mar.	10	576	483	83.85	36	6.25	38	6.60	19	3.30
May	10	512	185	36.13	220	42.97	106	20.70	1	0.20
Aug.	13	585	28	4.79	42	7.18	490	83.76	25	4.27
Oct.	14	490	25	5.10	7	1.43	382	77.96	76	15.51
Dec.	11	677	305	45.05	13	1.92	125	18.46	234	34.56
1941										
Feb.	12	743	631	84.93	6	0.81	45	6.06	61	8.21

Fig. 1- SEASONAL TREND IN THE DEVELOPMENT OF SEX FORMS OF FIRE ANTS IN THE PINEAPPLE FIELDS OF OAHU



Following the discing down of the pineapple plants, the nests along the field roads rapidly dissipated so that after the second discing, only a few weak nests remained. The large heaps of dead ant debris indicated death of most of the ants. In the wetland fields, *Pheidole* ants were scattered and became dominant after the plants were disced down.

Nests containing adult sex forms apparently exist throughout the year but they seem to reach a low level during the months from February to May and a peak during October or November. This trend has been shown in wind trap records previously reported (Proc. Haw. Ent. Soc., X, No. 3, pp. 429-435, Aug. 1940), but most of the individuals caught were males. It is during these peak months that dissemination of males and females and initiation of new colonies occur most extensively. It is also during this time that dissociation of the nests takes place, resulting in nearby heaps of dead ant debris.

The phenomenon of fire ant flights has been observed under both laboratory and field conditions to occur almost precisely at sunset. Unlike *Pheidole* ant flights which appear in great swarms and most noticeably in the mornings after heavy rains, fire ant flights pre-

sumably take place every night during the season of sex maturity with only a comparatively few individuals flying off from a single nest at any one time. Although both males and females fly away, there apparently is no such thing as a nuptial flight. Probably mating takes place within the nest and flight is primarily for dissemination.

The behavior of a colony preparatory to flight presents an interesting scene. Activity in the nest generally begins from about a half hour prior to sundown, when the winged sex forms gradually start to come out of the nest. The excitement is mainly confined to the winged forms which run about and spread themselves on the surface of the ground or clamber up nearby pineapple plants, weeds or trash. By sunset, the commotion ceases except for the few individuals which are limbering up their wings for flight. Flight begins immediately after sunset and continues for about an hour to an hour and a half, a few individuals flying off from time to time. Despite the excitement and the presence of both sexes, mating does not take place at this time. Only a small fraction of the total number of individuals present actually flies away; the rest slowly return into the nest after dark.

It has been observed that dealate females or queens were most common and easily found on the surface of the ground under the harvest trash during the fall months. As the peak of sexual maturity and flight of this ant usually coincide with the preparation and planting of new fields, such fields afford ideal conditions for those queens which happen to fly into them. Since it has been demonstrated that a solitary queen can initiate a colony of micrergates, it is conceivable that new colonies can be founded without much difficulty within a newly planted field even if previous infestations had been eliminated prior to planting. That this seems to be the case is shown by the fact that despite the eventual domination of the weedy wetland ratoon fields by *Pheidole* ants, these fields are found to have become reinfested with fire ants soon after the planting of a new crop of pineapple.

As has been noted before, the immature forms of the fire ant are brought to the surface of the nests during the wet months but are kept down at the moist depth of from 8 inches to a foot or more during the dry months. This reaction seems to be one primarily involving moisture as the young are brought to the surface following a soaking rain even during the summer or kept at a depth during a dry winter such as has been the case during the last year.

The nests were most frequently established either in the middle or at the ends of the beds along the north side of the roads when the beds ran in a north-south direction and in the middle or along the east side when the beds ran east and west. Though exceptions were numerous, it was often realized that the nests had been spaced at almost regular intervals of 10 beds, or about 60 feet apart. In the

wetland areas where the *Pheidole* ant invasion into the fields from the periphery was fairly rapid, situations were encountered every now and then where a few fire ant colonies had become isolated from their centrally occupied territory by the advancing *Pheidole* ants. Nevertheless, in general, the fire ants were able to maintain their ground even through the second ratoon period or probably longer if the field roads remained open.

SUMMARY

The developmental trend of the sex forms of the fire ant, *Solenopsis geminata* (Fabr.) var. *rufa* (Jerdon), has been ascertained by a 2-year survey of nests in the pineapple fields on Oahu. It has been found that the percentage of nests containing adult sex forms reaches a maximum sometime in the fall and a minimum in the spring. Flight has been observed to occur at sunset. The fact that females fly and that a solitary queen can initiate a colony of micrergates may account for the majority of the infestations in newly planted pineapple fields.